

6,306,563). It is respectfully asserted that this ground of rejection has been overcome by the instant amendment. The reference fails to show each element of the claimed invention. Particularly, the reference fails to teach a method for producing a polymer waveguide on a substrate in which a photomask is placed at a level above and not in contact with a core layer, and wherein the core is exposed through the elevated photomask in a vacuum or inert gas atmosphere. The applied reference only describes (col. 33, lines 8-38) the sequential steps of placing a sample having an at least partially polymerized lower cladding and an unpolymerized, liquid core material thereon into a vacuum bell jar, then bringing a photomask into contact with the liquid core material, followed by releasing the vacuum and then exposing the sample to actinic radiation in a purge box. This is different from the amended claim language which requires that the core composition be exposed to actinic radiation while in a vacuum, or in an inert gas atmosphere, through a photomask which is close to the core composition, but not in contact with it.

The proximity printing of liquid photoresists both controls the precise level of pre-cure of each individual state and also to achieves maximum coating uniformity. Any contact of the liquid core film and the photomask disturbs the film uniformity provided achieved during film deposition techniques, such as spin coating. The proximity printing process of the invention is carried out in a vacuum and nitrogen purge chamber that surrounds the substrate and the photomask. The vacuum or nitrogen purge can be applied to the liquid thin film in any desired combination to fully deoxygenate the film without disturbing the thickness uniformity or other characteristics of the film. Within this deoxygenated environment, a photomask can then be brought near the film, but not touching the film, to allow ultraviolet light exposure of the desired patterns. Superior waveguide uniformity and sidewall smoothness is ensured by the lack of mask contact.

Xu et al. does not teach a proximity exposure of a core composition while in a vacuum or in an inert gas atmosphere, e.g. nitrogen atmosphere. Xu et al. docs state at col. 24, lines 26-29, that masked exposure of their photopolymerizable materials may include contact,

proximity and projection techniques for creating a patterned film. However, there is nothing in Xu et al. that teaches or suggests that such proximity or projection exposure techniques may be conducted while in a vacuum or in an inert gas atmosphere. The disclosure of the reference only discusses contact exposure through a photomask while a sample is in a purge box. More particularly, the reference also fails to disclose that such contact exposure is conducted under a vacuum or in an inert atmosphere at all. Rather, the reference states that the vacuum is released prior to exposure, and never states that their purge box is flushed with an inert gas. In fact, Xu et al. suggest the contrary.

Looking to Example G at col. 32, line 59 to col. 33, line 38, Xu et al. states that after applying the core composition and evacuating it to remove bubbles, that the sample is placed in a purge box as was the lower cladding composition, and exposed. While this does discuss the substrate/lower cladding/core composition sample being placed into a purge box subsequent to evacuating the core under a vacuum, it *does not state that the core composition is purged with nitrogen in the purge box*. The reference only states that the sample is placed into the box and exposed through a photomask. This is important because the Example clearly states that the sample is removed from vacuum prior to exposure.

Moreover, the Examiner is directed to column 29, lines 10-13 of the applied reference where Xu et al. specifically state that their samples are either purged with nitrogen, or alternately the container holding the samples can be evacuated under a vacuum to remove oxygen. Nowhere in the disclosure does Xu et al. teach that a waveguide sample is placed into and exposed within an inert gas atmosphere after being removed from a vacuum. The reference does also state at col. 45, lines 38-41 that a sample may be subjected to a final UV cure in a nitrogen ambient atmosphere to effect a full polymerization of all the waveguide layers described in Example L. However, this exposure is *not conducted through a photomask* and therefore does not apply.

In sum, the applied reference does not show that their core composition may be exposed

through a photomask that is not in contact with the core composition while being maintained in a vacuum or in an inert gas atmosphere. Furthermore, while the applied reference does show a contact exposure through a photomask in Example G, the reference explicitly states that their sample is removed from a vacuum prior to exposure and does not describe their contact exposure as being conducted in an inert gas atmosphere. In addition, while Xu et al. does teach that any of contact, proximity or projection masked exposure techniques may be used, it does not teach that these techniques may be conducted either under a vacuum or in an inert gas atmosphere. For these reasons it is respectfully submitted that the reference does not show each element of the amended claims and it is requested that the rejection now be withdrawn.

It is further submitted that should the examiner withdraw the 35 U.S.C. 102 rejection and consider substituting a 35 U.S.C. 103 rejection, that since the instant application was filed after November 29, 1999 and both this application and Xu, et al were copending and subject to an obligation of assignment to the same person, that this application takes the benefit of the American Inventor's Protection Act and Xu et al is not available as 35 U.S.C. 103 prior art.

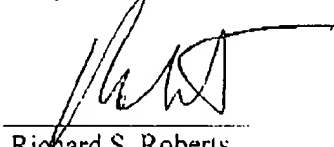
Claims 29-30 stand rejected under 35 U.S.C. 102(b) over Chiang et al. (U.S. patent 5,106,211). It is respectfully submitted that the rejection has been overcome by the instant amendment. Claim 29 has been amended into product-by-process format in which it is specified that the polymeric waveguide of the invention is formed by the claimed process of claim 1.

Chiang et al. teaches polymeric channel waveguides formed from an excimer laser photoablation procedure. Their waveguides may include a first cladding layer on a substrate, an optical waveguiding layer, and a second cladding layer on the waveguiding layer. The reference teaches that these layers may be ablated into longitudinal sections with an excimer laser to form a smooth wall channel waveguiding ridge. The reference also teaches the deposition of a third cladding film on top of the second cladding material.

Chiang et al. does not teach the steps of deoxygenating the layers of their waveguides as described by Applicants, nor does Chiang teach a proximity exposure of a core composition through a waveguide which is not in contact with the core composition. Since Chiang, et al do not form their waveguide by deoxygenation of each of the core, underclad, overclad and buffer, it is submitted that the obtained structure is inherently different from the instant structure. Although the layering may be similar, the composition of each resulting layer would be different due to the lack of deoxygenation. For these reasons, it is respectfully submitted that the amended claim 29 and dependent claim 30 are not anticipated by Chiang et al. and it is requested that the rejection be withdrawn.

The undersigned respectfully requests re-examination of this application and believes it is now in condition for allowance. Such action is requested. If the examiner believes there is any matter which prevents allowance of the present application, it is requested that the undersigned be contacted to arrange for an interview which may expedite prosecution.

Respectfully submitted,



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I hereby certify that this paper is being facsimile transmitted to the Patent and Trademark Office (FAX No. 703-872-9310) on October 31, 2002.



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MARKED-UP COPY OF THE AMENDED CLAIMS

1. (Amended) A method for producing a polymer waveguide on a substrate, the method comprising the steps of:

a) providing a substrate and then

b) conducting (i) or (ii) or (iii):

- (i) coating a layer of a liquid, photosensitive buffer composition onto the substrate; then deoxygenating the buffer layer under the conditions of vacuum, purging with inert gas, or a combination of vacuum and purging with inert gas; overall exposing the deoxygenated buffer composition to sufficient actinic radiation to only partially polymerize the buffer composition to a level below a substantially full curing of the buffer composition;
- (ii) coating a layer of a liquid, photosensitive underclad composition onto the substrate; then deoxygenating the underclad layer under the conditions of vacuum, purging with inert gas, or a combination of vacuum and purging with inert gas; overall exposing the deoxygenated underclad composition to sufficient actinic radiation to only partially polymerize the underclad composition to a level below a substantially full curing of the underclad composition;
- (iii) coating a layer of a liquid, photosensitive buffer composition onto the substrate; then deoxygenating the buffer layer under the conditions of vacuum, purging with inert gas, or a combination of vacuum and purging with inert gas; overall exposing the deoxygenated buffer composition to sufficient actinic radiation to only partially polymerize the buffer composition to a level below a substantially full curing of the buffer composition; followed by coating a layer of a liquid, photosensitive underclad composition onto the buffer layer; then deoxygenating the underclad layer under the conditions of vacuum, purging with inert gas, or a combination of vacuum and purging with inert gas; overall exposing the

deoxygenated underclad composition to sufficient actinic radiation to only partially polymerize the underclad composition to a level below a substantially full curing of the clad composition; and

- c) coating a layer of a liquid, photosensitive core composition onto a surface of the buffer layer or the clad layer; then deoxygenating the core layer under the conditions of vacuum, purging with inert gas, or a combination of vacuum and purging with inert gas and then covering the core layer with an inert gas atmosphere;
- d) positioning a photomask having a waveguide pattern, at a level above, substantially parallel to, and [either in contact with the core layer or] not in contact with the core layer, and then imagewise exposing the photosensitive core composition through said photomask, to sufficient actinic radiation to only partially polymerize the core composition to a level below a substantially full curing of the core composition but beyond the gel point of the core composition, while maintaining the core coated substrate in an inert gas atmosphere;
- e) developing the exposed core composition layer to remove the non-image areas while not removing the image areas;
- f) coating a layer of a liquid, photosensitive overclad composition over at least the image areas of the core composition; then deoxygenating the overclad layer and all underlying layers under conditions of vacuum, purging with inert gas, or a combination of vacuum and purging with inert gas; overall exposing the overclad composition, under an inert gas atmosphere, to sufficient actinic radiation to substantially fully cure, the buffer composition layer if present, the clad composition layer if present, the core composition layer and the overclad composition layer.

29. (Amended) A polymeric waveguide formed by the process of claim 1, [which comprises

a substrate;

a polymeric patterned core on the substrate; and

a polymeric buffer layer, or a polymeric underclad layer, or sequentially both a polymeric buffer layer and a polymeric underclad layer between the substrate and the polymeric patterned core;] wherein the polymeric buffer layer, or polymeric underclad layer or both the polymeric buffer layer and a polymeric underclad layer have a pattern which are along and symmetrical with the core.

Please add the following new claims:

31. (New) The process of claim 1 wherein said partial polymerization steps are conducted such that at least 10% of each of said photosensitive compositions remains unreacted following exposure to actinic radiation.

32. (New) The process of claim 1 wherein said partial polymerization steps are conducted such that at least 25% of each of said photosensitive compositions remains unreacted following exposure to actinic radiation.